"LUCIAN BLAGA" UNIVERSITY OF SIBIU
"VICTOR PAPILIAN" FACULTY OF MEDICINE

MATEI CLAUDIU

CONTRIBUTIONS TO THE TREATMENT OF ORBITAL TUMOURS

Summary of the PhD thesis
for obtaining the PhD degree in medical sciences

Field: Medicine
Speciality: Ophthalmology

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SPECIAL PART

8.1. Introduction

Due to the wide variety of tissues it contains, the orbit may be the seat of numerous tumoral pathological processes.[2,59] Orbital tumours represent replacement processes developed by the abnormal cell proliferation, placed on the border of two structurally and functionally different regions: facial region and cranial region.[32] There is no medical or surgical specialty to solve exclusively this condition, so that the orbital tumour pathology can be treated surgically by physicians specialized in ophthalmology, neurosurgery, oral and maxillofacial surgery, oto-rhino-laryngology surgery.

Modern surgery includes the orbital surgery within the skull base surgery, this knowing an important development in the last decades. This was possible due to the introduction of large-scale radiological investigation procedures, computer tomography (CT) and magnetic resonance imaging (MRI) with 3D reconstruction techniques, due to the progress of the microsurgical techniques and instrumentation, of minimally invasive surgical techniques, of the coagulation instruments, but also due to the emergence of biologically inert materials used in the reconstruction of skull base procedures.

The surgical treatment addressing all orbital tumours includes numerous surgical approaches chosen depending on the location and extent of the tumour and on the overall clinical status of the patient.

Addressing this borderline pathology within some multidisciplinary teams, including neurosurgeons, ophthalmologists, physicians specialised in oto-rhino-laryngology, specialists in oral and maxillofacial surgery, medical oncologists and radiotherapists can provide superior functional oncological outcomes and last but not least, aesthetic outcomes.

I whish to thank everyone who helped me to develop this thesis, firstly my supervisor, Prof. Adriana Stănilă, head of the Ophthalmology Clinic of Sibiu, an expert, a scientist, a very rare model for those who want to perfect as doctors.

I express my gratitude to Prof. Stephen John Florian, head of the Neurosurgery Clinic of Cluj-Napoca, who was not only my supervisor and mentor residency, but also a model of human and professional conduct.

I also wish to say thank you to all my colleagues of the Ophthalmology, Neurosurgery Clinic, to my colleagues - anesthetists, radiologists, pathologists, oncologists, neurologists and family doctors who have supported me in preparing this study.

I thank my family for the encouragement, understanding and patience they supported me during the elaboration of this paper.

8.2 Purpose of the research

Orbital tumours represent a very complex pathology, rarely encountered in the clinical practice, with many implications regarding the quality of life of these patients in terms of oncology, aesthetics and functionality.

The purpose of this study is:

- To highlight some specific elements of diagnosis for the different types of orbit tumours;
- To establish certain indications of surgical therapy, tailored to each case;
- To increase the knowledge of surgical anatomy of the cranio-orbital junction, vascular-nervous passage region between skull and orbit, of a great complexity;
- To perfect the microsurgery techniques;
- To promote some minimally invasive surgical approaches consistent with the general attitude of modern surgery, but at the same time responding to the radical oncologic criteria, as well as to develop traditional surgical approaches;
- To establish some clinical and neuroimaging criteria for assessing the surgical and postoperative outcome.

8.3 Material and methods

The achievement of superior results in the treatment of the patients diagnosed with orbital tumours is based on the multidisciplinary and multimodal approach of this pathology. These superior results refer to three key issues:

- The oncological aspect, with increased survival rate in terms of a better quality of life;
- Visual functional aspect, which involves the restoration or the preservation of the visual function;

- Esthetical aspect which contributes significantly to achieving the best possible quality of life.

The incidence of this pathology is difficult to estimate, so that in order to complete this study, we used two groups of patients. A control group treated in the Neurosurgery and Ophthalmology Clinic within the County Emergency Clinical Hospital of Sibiu, in the period January 2007 - December 2011, accounting for 91 cases. Another studied group was represented by patients diagnosed and treated for tumours with orbital structures involvement in the university centre of Cluj-Napoca, between January 2007 and December 2008, under the guidance of Prof. Dr. Florian Ştefan, in a number of 18 patients.

The total number of patients was 109, gathered in the study groups of the two clinics that provided the casuistry. Of all patients, we selected those with tumours of the orbit, excluding the cases with eyelid or eyeball tumour pathology. The number of the patients included in the study was 53.

Thus, the present study is a prospective study started in January 2007 and completed in December 2012.

The data were collected from the patients' observation charts, admissions registers, surgical protocols and histopathological findings.

All patients received clinical and neuroimaging examinations: computer tomography and magnetic resonance. In some cases, the preoperative paraclinical balance was completed with specific endocrine, ophthalmological and neuro-ophtalmological examinations.

All the patients in the study were operated, and subsequently, depending on the histopathological diagnosis of the tumour, the treatment was continued in the Oncology Clinic.

The histopathological examinations of the study patients were performed, both in the Pathological Anatomy Clinic within the university centre of Sibiu and within the Pathological Anatomy Departments, Pathological Anatomy Laboratory within the university centre of Cluj-Napoca. The histological images were obtained with the help of Mr. Eugen Radu, assistant professor in Pathological Anatomy, university centre of Sibiu, and of Mrs. Lupean Adina from the Pathological Anatomy Clinic within the County Emergency Clinical Hospital of Sibiu.

Postoperative follow-up was performed for the entire study group, the patients being subjected to clinical controls and periodic imaging, 3-6 months after the surgical intervention.

For each patient, I noted the type of the approach, the reconstructive solution used to restore the anterior stage of the skull base, tumour resection level, tumour histology, clinical status at discharge assessed by the Karnofsky score, any possible complications or tumour recurrence. Not ultimately, I appreciated the quality of life after the surgery, as well as the perioperative mortality and morbidity.

Orbital tumours are divided by most clinicians, based on the tumour relation with the muscle cone made up of the extraocular muscles and their fascia, into three broad categories: intraconal, extraconal and intracanalicular. This division I have also used in this study.

The orbital surgical approach involves, both detailed knowledge of anatomy and physiology in terms of the visual analyzer and of the neighbourhood craniofacial structures, as well as knowledge and mastery of the microsurgical techniques.

The cranio-orbital junction is a vascular-nervous passage area I studied in detail, both by researching the specialty literature and by conducting some anatomical studies through body dissections. This was possible with the permission of Prof. Petre Florescu, Head of the Department of Pathological Anatomy and of Dr. Magdalena Petrescu, Head of Laboratory of Pathological Anatomy of the University Centre of Cluj-Napoca.

I also issued some personal opinions on orbit pathology by reference to the traineeships abroad, in France at the Clinical Hospital of Colmar and in Germany, ZentralKlinik Bad Berka, where there is an ample experience in the transcranial approach of the orbital tumour pathology.

Chapter IX
RESULTS

9.1. Demographic aspects of the study group

In the study group, 32 cases (60.37%) belonged to females and 21 cases were (39.62%) males.

Of the total of 53 cases under study, 2 cases (3.77%) were younger than 9 years old, 3 cases (5.66%) belonged to the age group of 10 to 19 years old, 5 patients (9.43%) were included in the age group of 20-29 years old, 5 cases (9.43%) in the age group of 30 to 39 years old, 14 cases (26.41%) were between 40 - 49 years old, 11 cases (20.75%), between 50 - 59 years old, 5 cases (9.43%) were over 70 years old. It can be noticed that this is a heterogeneous group in terms of age of the patients under investigation. Distribution casuistry on origin environment revealed a higher proportion of the patients in urban areas, 41 cases, accounting for 77.35%, compared with 12 cases, accounting for 22.64%, from rural areas.

9.2 Patients' symptomatology upon admission

Depending on the location of the orbit, the evolutionary stage and the patient's general condition, orbital tumours symptomatology can be extremely heterogeneous. The most common signs and symptoms in the patients in the study were represented by: protrusion of the eyeball, or exophthalmia, orbital pain and headache, ocular motility disorders causing diplopia, blurred vision and other symptoms: lagophthalmos, pupillary changes, abnormal secretion and lachrymal flood, sensitivity disorders, neurological disorders, systemic damage.

Table 9-1: Studied patients' symptomatology

Exophthalmia	Visual disorders	Orbital pain or headache	Ocular motility disorders	Other signs and symptoms
31 cases (58,49%)	12 cases (22,64%)	22 cases (41,50%)	16 cases (30,18%)	42 cases (79,24%)

9.3 Orbital tumours diagnosis

The clinical diagnosis of orbital tumours has been preoperatively supported by the imagistic means and, postoperatively it has been confirmed based on the histopathological examination. The imaging diagnosis was performed in all cases under study. It consisted of ultrasound, computed tomography and magnetic resonance.

Histopathologial diagnosis

The tumoral diagnosis revealed a large heterogeneity of the group, a well known fact due to the wide variety of tissues that can be found at orbit level, bringing about a variety of tumour types. Thus, within the study group, one can see that I have encountered secondary tumours of the orbit in 32 cases (60.37% of cases), and the remaining 21 cases (39.62%) were diagnosed with primary tumours.

Regarding the secondary tumours, it is worth mentioning that it was about distant metastases in 4 cases (7.53%), and in the remaining 28 cases (52.83%), it was about tumours invading secondarily the orbit from the neighbouring structures, of which 25 cases (47.16%) were located at the cranio-orbital junction level, invading the orbit from the endoskull, and in 3 cases (5.66%), the orbit has been secondarily affected within some nasal-sinus tumours. Metastasis occurred in the following conditions: breast cancer 2 cases, rectal adenocarcinoma 1 case, lung adenocarcinoma 1 case.

Table 9-2 Orbital secondary tumours through neighbourhood invasion

Tumour	No. of cases
Sphenoid wing meningioma	
- **en plaque**	3
- **inner third of the sphenoid wing**	
- **tuberculum sellae**	14
	8
Para-nasal sinuses adenocarcinoma	
	2
Esthesioneuroblastoma	1

So, within the cranio-orbital junction, there were 25 cases (47.16%) of meningiomas, including meningioma of the inner third sphenoid wing in a number of 14 patients (26.41%) and the remaining 8 patients (15.09%) presented tuberculum sellae meningioma, respectively 3 cases (5.66%) show “en plaque” meningioma.

From the histopatological point of view, cranio-orbital junction meningiomas were the following: menigotelial meningioma 9 cases (16.29%), fibroblastic meningioma 5 cases (9.43%), transitional meningioma 4 cases (7.54%), atypical meningioma 1 case (1.88%), meningioma with psamomatous bodies 3 cases (5.66%), “en plaque” meningioma 3 cases (5.66%).

Within the 21 patients with primary orbital tumours, the most numerous were represented by the cavernous hemangioma, as well as by the tumours of the lachrymal apparatus.

Table no. 9-3 Primary tumours of the orbit

Tumour	*No. of cases*
Cavernous hemangioma	7
Capillary hemangioma	2
Lymphangioma	2
Optic nerve glicoma	3
Optic nerve meningioma	1
Adenoid cystic carcinoma of the lachrymal gland	2
Lachrymal sac carcinoma	1
Lymphoma	3

Regarding their location, classically, the intraconal, extraconal or the mixed classification is used. Of the 21 cases of primary orbit tumours, 12 tumours (22.64%) were intraconally located, 5 tumours (9.43%) were located extraconally and the remaining 4 (7.54%) had a mixed intraconal-extraconal placement.

9.4 Surgical approaches

All those 53 patients received a surgical procedure. Regarding the surgical treatment in the patients in the study, five biopsies were performed (9.43% cases) in the patients with: 1 case of pulmonary adenocarcinoma metastasis, metastatic breast cancer 2 cases, 2 cases of lymphoma.

The indication for biopsy was determined by: the older age of the patient, the patient's associated defects, imaging features, suggestive of lymphoma or orbital pseudotumour.

In 36 cases (67.92% of cases), tumour location imposed choosing a transcranial approach, and in 16 cases, meaning 30.18% of cases, the orbital tumours were approached transorbitally.

As I previously mentioned, in one of the cases, there was a patient with skull base tumour, anterior fossa, with the invasion of the maxillary and ethmoid sinus and secondary orbital invasion. In this case, it has been resorted to a mixed trans-sinusal and transcranial approach, so after the tumour resection of the maxillary sinus, trans-sinusal ablation of the infraoptic intraconal orbital tumour has been succeeded, and afterwards, by transcranial approach, the medial, supraoptical and intraconal tumour has been resected

Among the 36 cases (67.92%) that underwent transcranial approach, this one was represented by the fronto-temporal classic approach in 26 cases (49.05%), rarely a bifrontal approach being required. In the remaining 10 cases (18.86%), the fronto-temporal craniotomy associated with higher orbitotomy has been practiced. This orbitotomy was always performed leaving in place the supraorbital arch.

9.4.1 Transcranial approach of the orbit

For the transcranial approach of the orbit, I used the hemicoronal scalp incision. Later, I proceeded to the calvarial exposure and I practiced a fronto-temporal craniotomy. This approach or the fronto-temporal craniotomy extends almost to the median line, in cases of apical orbital tumours. Subsequently, osteotomy is practiced at the same time with the lifting of the orbital roof.

The superior and lateral margin resection of the orbit, I personally consider that can be avoided in most of the cases, being necessary or useful only in large tumours or when a significant brain retraction (upper apical tumours) is foreseen; however, I consider advantageous the remaining in place of the orbit margins, performing only the resection of the orbital roof. The resection surface of the orbital roof varies according to the tumour location. Optic canal decompression is done in the case of the optic nerve tumours (meningiomas, gliomas). I preferred the orbital roof reconstruction to be performed with titanium Dynamic Mesch. Peri-orbital plasty has been made with periosteum or fascia lata.

9.4.2 Lateral approach of the orbit

Lateral orbitotomy is useful in the retrobulbar lesions, in lachrymal gland lesions, with the possibility to be extended to those localized posteriorly in the orbital cavity. The procedure involves temporarily removing the side wall of the orbit, thus providing full access to the lachrymal gland and to the tumours located laterally, superolaterally or inferolaterally. The patient, under general anesthesia, is positioned in supine with the head turned controlaterally.

Skin incision used in my personal experience is the classical incision and starts from the brow superolateral extremity, with a slightly inferior arched trajectory up to the halfway height of the lateral wall, in order that subsequently to go straight back 3 cm long, called the Stalard incision. Note, that there are described and used 11 types of incisions for this approach. Osteotomy can be performed based on the surgeon' experience in many ways, with picking bone clips or with electric instruments used in craniotomy.

Thus, two bone incisions may be performed, one superior and one inferior on the orbital arch, slightly inclined one towards the other, and are extended by Dalgren type cutter or by picking bone clips, making a "wedge". Thus, the lateral wall is lifted, leaving a free bone flail, including the orbit edge and extending posteriorly according to the orbit pathology, until the orbital apex. Afterwards, we can proceed to the resection of the tumour, then to the bone flail fixation with transosseous suture or with titanium screws and plates, and at the end of the surgical intervention, I usually leave a slightly suction drainage of Hemovac type.

9.4.3 Cranio-orbital junction approach

The cranio-orbital junction approach was performed in all those 25 cases with pathology located at this level, through classical fronto-temporal approach, with differences in the location of the disease process.

Thus, for the lesions intersecting the optical foramen, an extended fronto-lateral craniotomy can be performed, towards the median line, while for the lesions of the sphenoid wing, one can proceed to a fronto-temporal or pterional classical approach.

A fronto-temporal, arcuate incision of the scalp is performed, 1 cm above the tragus, posteriorly to the hairline insertion until the median line. Once craniotomy and hemostasis are achieved, one can proceed to the extradural dissection. Craniotomy is necessary to extend over the temporal pole. The extradural dissection is performed

latero-medially and the orbital wall supero-laterally is resected using the drill until highlighting the meningo-orbital artery. Right medially to this arterial ram, there is the superior orbital fissure. Dura mater incision is made parallelly to the skull.[3,40.] Subsequently, depending on the location of the tumour process, one can proceed to the lift of the frontal lobe and to the Sylvian fissure dissection. One can also get subfrontally through the Sylvian fissure, outlining the optic nerve and later on, the carotid vascular axis. If it is a tumour located in the superior orbital fissure region, we proceed to highlighting the pathological process and tumour resection, according to the principles of microsurgery, in a “piecemeal resection” manner by fragmentation.

The tumour can sometimes invade the periorbita or even the lateral orbit. In these cases, periorbital fascia incision is practiced (which can be excised if tumour infiltrated). The superior right is medially departed, and the lateral right, laterally; the orbital lateral component of the sphenoid wing meningiomas is resected, initially with inner debulking, preserving the extraocular muscle nerves.[40] For the tumours that invade the optic canal, it is necessary to open it, which is done by lifting the upper wall.

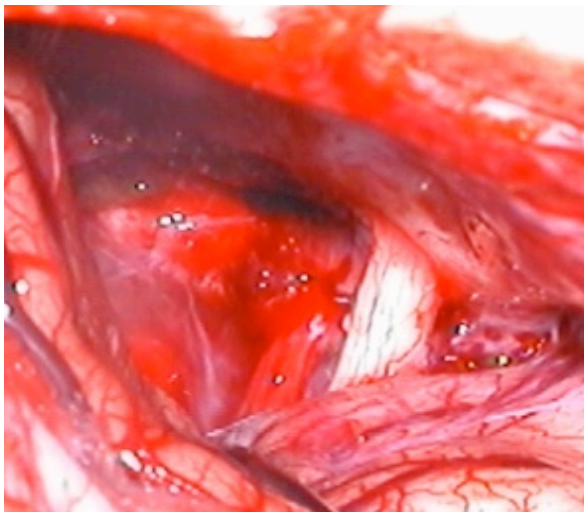


Figure 9-45. Intraoperative aspect in the case of tuberculum sellae meningiomas. The optic nerve can be seen, with the open eye on the entry into the optic cannal, the temporal and frontal lobe resected, the Sylvian fissure partly dissected and the completely resected tumour.

9.5 Results of the surgical therapy

In the study group, 40 patients received a total tumour resection (75.47% of patients), 8 patients (15.09% of patients) a subtotal resection, and 5 patients (9.43% of patients) received puncture biopsy.

It is to be mentioned that in 5 cases (9.43%), extemporaneous examination was used; in these cases, it was important to know the exact extent of tumour excision, aiming at safety margins; it was about: a lachrymal gland tumour 2 cases, a tumour of paranasal sinus 2 cases and one case of rectal adenocarcinoma metastasis.

Patient status at discharge was assessed by the Karnofsky functional score; the low scores were due primarily to the underlying disease (breast cancer, extended carcinoma of facial sinuses) age and associated disorders.

Table 9-4: Karnofsky score in the study group

Score	*Description*	*Number of cases*
100	Normal	**23 cases (43,39%)**
90	Minor symptoms, normal activity	**14 cases (26,41%)**
80	Symptoms, develops activities with effort	**5 cases (9,43%)**
70	He/she can take care of himself/herself; cannot make things	**3 cases (5,66%)**
60	Need occasionally assistance	**6 cases (11,32%)**
50	Need considerable assistance and frequent care	**2 cases (3,77%)**
40	Need special care	–
30	Severe disease, hospitalization	–
20	Need vital support	–
10	Dying, imminently fatal process	–

9.6 Complications

Within the study group, there were no intraoperative incidents. In 4 cases, intraoperatively, during the tumour resection, communication between the cranial cavity and exo-skull was made, but this was not considered an incident, because the tumour invaded, both the dura mater and the anterior cranial fossa floor, so they had to be removed. The reconstruction of the skull base was achieved with titanium Dynamic Mesh, and dura mater plasty was done with regional periosteum. Postoperatively, in order to avoid the pressure on the dural plasty, a continuous lumbar drainage was established for 3-5 days. Postoperatively, we recorded the following complications:

- CSF fistula in two cases, of which in one reintervention was required for closing the fistulous orifice;

- Postoperative bleeding with postoperative hematoma in 2 cases;
- A case of infection, one week postoperatively;
- 2 cases with postoperative superficial wound infection;
- A case of keloid scar after a previous approach for lymphangioma, which was treated surgically in the plastic surgery clinic.

Perioperatively, in the study group, I did not register any death, and the subsequent development of cases was good and very good. Regarding the occurrence of relapses, I recorded only 4 relapses, probably because the time for follow-up was insufficient to detect any possible recurrence, from this point of view, the range time being very short.

4.5 Evolution and postoperative follow-up

Postoperatively, at discharge, the patients' health status was evaluated by the Karnofsky index, the results being presented in the above table. The lower values registered in some cases were mainly due to the underlying disease (breast cancer, extended carcinoma of facial sinuses) age and associated disorders. I realized a postoperative follow-up algorithm taking into account the histological type, grade and tumour ablation, patient status at discharge, achieving a score that I called the postoperative score. (Table 9-5).

Table 9-5.

Determining factor	Score
Histological type	Tu Malign 1 point Tu Benign 0 point
Tumour resection degree	Biopsy 2 points Subtotal ablation 1 point Total ablation 0 point
Status upon discharge	Karnofsky < 70 1 point Karnofsky ≥ 80 0 point

Taking into account the score at discharge, I proceeded in the following manner:

- The patients with score 0 were called to the clinical control and imaging at 6 months;
- For the patients with score 1 – clinical control and imaging at 3 months;
- For the patients with score 2-4, at one month.

Chapter X
DISCUSSIONS

10.1 Discussions about the demographic aspects

10.1. 1 Discussions about the distribution of cases according to gender

In the group of the patients being investigated, there was a higher incidence of the orbital tumour pathology among the female patients. Sibiu county population is of 423,125 inhabitants, of whom 217,527 are female and 205,598 are men, a proportion of 51.40% to 48.59% for women. I think that this predominance of female patients is due to the fact that the female population is more (51.40% women, 48.59% men - in the general population of the latest official published census), but also because the average life duration is greater in women - 76 years compared with 68 years for men.

10.1.2 Discussions about the distribution of cases on age groups

The highest incidence has been recorded in the patients belonging to the age group of 40-49 years old, with 14 cases (26.41%) and 50-59 years old with 11 cases (20.75%). Cases were however registered in all age groups. Obviously, the patients with orbital metastases were represented by people aged over 50 years old, being about metastasis of cancer of the rectum, breast or paranasal sinuses. The peak incidence recorded in the age group of 40-49 years old was due to the fact that many cranio-orbital junction tumours are represented by meningiomas and have their peak incidence at this age.[2, 57,62]

10.1.2 Discussions about the distribution of cases according to the origin environment

Repartition of casuistry on origin environments revealed a greater proportion of urban patients, 41 cases, accounting for 77.35%, compared with 12 cases, accounting for 22.64%, patients from rural areas. Of course, this may be due to numerous reasons, among which the most obvious is Sibiu county population distribution; on average 67% of the population is living in cities. Other causes include the easier addressability to doctors and perhaps a more active health education through access to media of the urban patients.

10.2 Discussions about symptomatology

Depending on the location at the level of the orbit, the evolutionary status and the general condition of the patient, the symptoms of orbital tumours can be extremely heterogeneous. The most common signs and symptoms in the patients in the study were the eyeball protrusion or exophthalmia, in 31 cases representing 58.49%.

This percentage corresponds to the literature data, which also show that the most common symptom in orbital tumour disease is the exophthalmia.[2,18.38]

This finding corresponds to the literature data, where it is also showed that the most common manifestation of an orbital tumour is the eyeball protrusion or exophthalmos, cited by authors with different frequencies varying between 75-84%. Few cases of orbital tumours are cited in the literature as being exophthalmos, about 1%. The true protrusion must be distinguished from the eyeball eyelid edema, which can create a false impression to an exophthalmos and therefore, the accurate diagnosis is made with the exophthalmometer.

Regarding the regional pain or headache, it was present in 22 patients, meaning 41.50% of the patients. Regarding the sensation of pain and headache present in the clinical picture of the patients with orbital tumours, it is of marked intensity, especially in advanced stages. Usually, upon diagnosis, the patient experiences a sensation of intraocular or intraorbital pressure. The pain given by an orbital tumour is usually located more or less constantly and frequently with a night-phase and it is difficulty solved by the usual painkillers.

Diplopia caused by the extraocular muscle imbalance was one of the major symptoms at the onset, being reported in 16 patients, 30.18%. It was present, both in the patients with intraconal tumours and in the patients with extraconal tumours..

In one case, a patient with adenoid cystic carcinoma of the lachrymal gland with the invasion of the external right muscle presented diplopia since the onset. The examination of the extraocular muscles in the patients with tumours of the orbit is important, bringing preliminary data on the nature or origin of the pathological process. Thus, ocular motility disorders that accompany the infectious or inflammatory pathological processes are growing rapidly and can be intensely painful. Ophthalmoplegia in Graves' disease develops gradually, without pain and in some cases, it may precede exophthalmos.[66]

In the study patients, the decrease of the visual acuity occurred in 12 cases, accounting for 22.64%. This was of varying degrees, from ½ to no light perception. Note that it makes part of the late signs of the orbital tumour disease, except for the cases of tumours of the optic nerve or of those of cranio-orbital junction. There are several less common signs and symptoms in the patients with orbital tumours. Thus, there may occur lagophthalmos, pupillary changes, abnormal sensitivity in the supraorbitar nerve territory, infraorbital nerve paresthesia, lacrimation, abnormal lacrimation objectified by the Schirmer test, neurologic disorders in a case of fronto-orbital meningioma, systemic involvement in the patients with orbital metastases and those with lymphoma.[66]

10.3 Discussions about the structure of the cases, according to the type of tumour

The field of histological examination has known as all medical fields, important technical and technological progress in the recent years. One of the most important developments is the immunohistochemistry. The histopathological examination of the tumour revealed a great heterogeneity of the study group. Within it, there were 32 cases (60.37% of cases) with secondary tumours of the orbit, and the remaining 21 cases (39.62%) were diagnosed as primary tumours. Within the secondary tumours, it is worth mentioning that 4 cases (7.53%) represented distant metastases and the remaining 28 cases (52.83%) were diagnosed as tumours invading secondarily the orbit of the neighbouring structures. Thus, metastasis occurred in the following conditions: breast cancer 2 cases, rectal adenocarcinoma 1 case, lung adenocarcinoma 1 case.

Cranio-orbital junction

In the secondary tumours, according to the Karcioglu classification, there are not only metastases of other cancers, but also tumours of the neighbouring organs that invaded the orbit secondarily. In the latter, a special place is held by the cranio-orbital junction tumours. In 28 cases (52.83%), the secondary invasion of the orbit occurred due to some neighbouring tumoral processes. Of these 28 cases, 25 (47.16%) were tumours located at the level of the cranio-orbital junction, and the other three (5.66%%) cases were paranasal sinus tumours.

So, regarding the cranio-orbital junction, there were 25 cases (47.16%) in which

the largest were meningiomas of the inner third sphenoid wing - 14 patients (26.41%) and the remaining 8 patients (15.09%) had tuberculum sellae menignioamas and 3 cases (5.66%) had “en plaque” meningioma.

Histopathologically speaking, cranio-orbital junction meningiomas were: meningothelial meningioma 5 cases (9.43%), fibroblastic meningioma 3 cases (5.66%), transitional meningioma 1 case (1.88%), atypical meningioma 1 case (1.88%), psammomatous bodies meningioma 1 case (1.88%).

Anatomical study

Cranio-orbital junction term has been used since 1973, and refers to the retro-obital region including the superior orbital fissure and the optic canal. The term of cranio-orbital junction includes the structures, which ensure the vascular-nervous passage from the cranial cavity towards the orbit, that is the optic canal and the superior orbital fissure medial portion. (Figure 10-5) [2.67]. The cranio-orbital junction is an area of great anatomical complexity, where multiple vascular-nervous structures can be found in a relatively tight place. Thus, different stages of suffering may be present, in terms of the oculomotor cranial nerves, optic nerve or of the vascular structures.

Figure 10-5. Cranio-orbital junction, posterior view from the left endocranium perspective and anterior view from the endo-orbital perspective. The optic canal can be viewed, traversed by the optic nerve and the ophthalmic artery; superior orbital fissure crossed by the extraocular muscles nerves and the orbital vein of the orbit; nerve structures are shown in green, the artery with red, the superior ophthalmic vein with blue and the sensitive and sympathetic roots of the ciliary ganglion with yellow (taken from my personal collection).

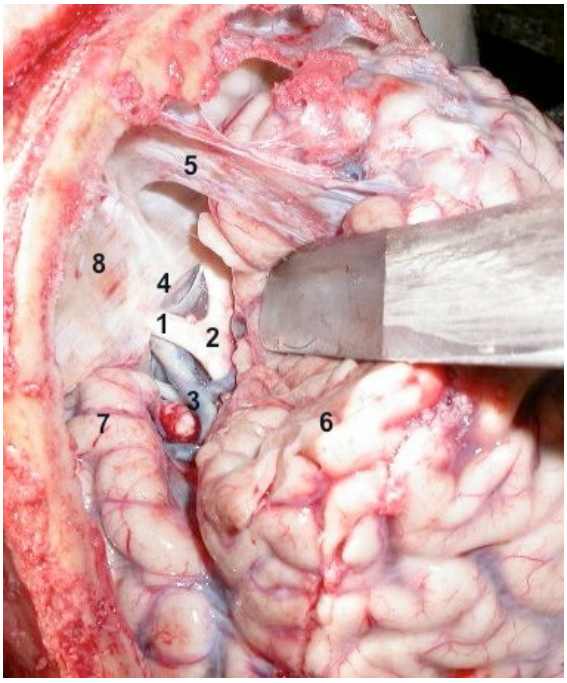


Figure 10-6. Frontal lobe retraction with the cranio-orbital junction; 1, optic nerve; 2, optic chiasm, 3, internal carotid artery with its bifurcation in two terminal branches, middle and the anterior cerebral artery; 4, tuberculum sellae; 5, falx cerebri; 6 retracted frontal lobe; 7 temporal lobe; 8, orbit roof.

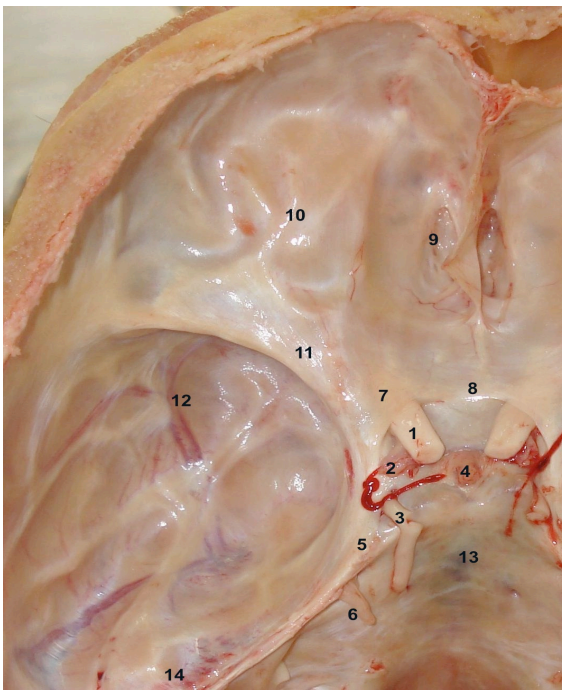
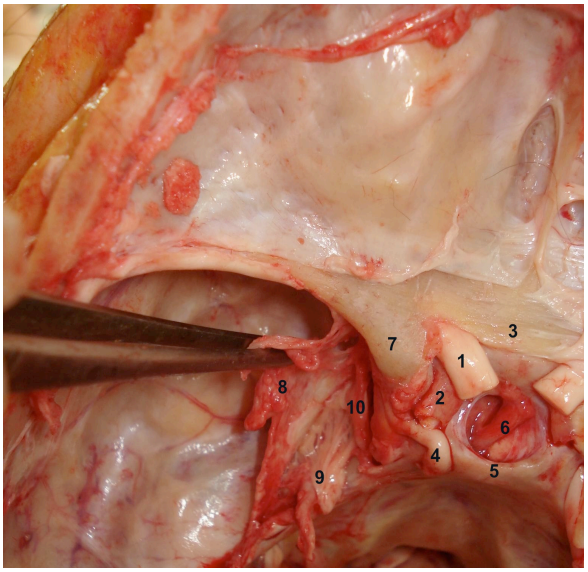


Figure 10-7. Exposure of the anterior and middle floor of the skull base 1, right optic nerve; 2, right internal carotid artery; 3 oculomotor nerve, common at the entry in the cavernous sinus; 4, pituitary stem 5, petroclinoid ligament; 6, trochlear nerve at the entry into the cavernous sinus; 7, falciform ligament which closes superiorly the intracranial optic canal; 8, tuberculum sellae; 9, ethmoidal lamina cribrosa; 10, orbit roof 11, dura mater over the small wing of the sphenoid; 12, middle cranial fossa; 14, temporary bone

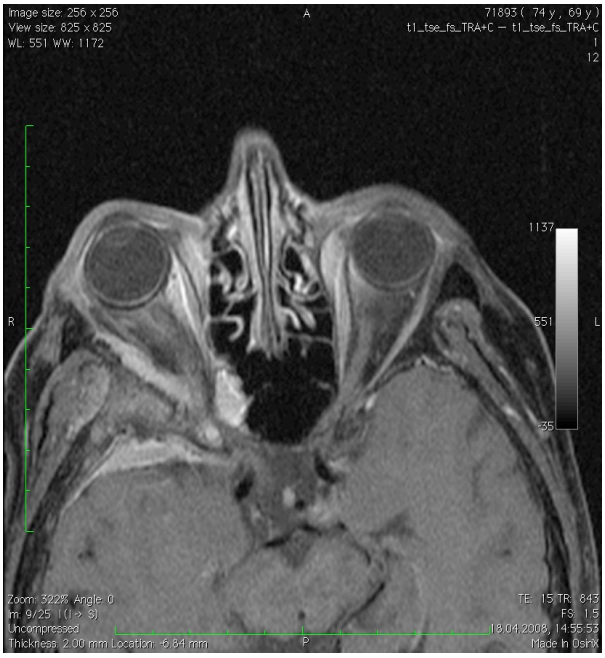


Anatomical study with the dissection of the skull base and presentation of the cranio-orbital junction, that I have accomplished within the Pathological Anatomy Department, with the consent of Prof. Florescu and Mrs. Petrescu. (Figure 10-6 - 10-8).

Figure 10-8. Dissection of the cavernous sinus taken from the right, with the lateral tractioning of its side wall. 1, right optic nerve 2, right internal carotid artery; 3, tuberculum sellae; 4, common oculo-motor nerve; 5 dorsum sellae; 6, sella turcica with the pituitary stem; 7, anterior clinoid process; 8, lateral wall of the cavernous sinus; 9 Gasser ganglion with trigeminal nerve branches - V1, V2, și V3; 10, trochlear nerve.

In the cranio-orbital junction meningiomas, there were three cases of “en plaque” meningioma. They are a special group of the meningioma located at the level of the sphenoid wing and are characterized by a flat dural “en plaque” involvement and a marked sphenoid hyperostosis produced by the bone tumour invasion.

Figure 10-12. MR examination, axial section, T1 sequence with contrast, female patient, 74 years old, admitted in the Neurosurgery Clinic of Cluj-Napoca for an “en plaque” meningioma.



The patients with “en plaque” menigioma were operated and a fronto-temporal approach has been practiced, with orbital decompression, tumour ablation with cranial nerve release at the level of the superior orbital fissure and the optic canal. The functional outcomes were good, with exophthalmia remission after surgery, and in two cases with improved visual function; one case has already had no light perception visual acuity upon admission (Figure 10-12)

Within the 21 patients with primary tumours of the orbit, the most numerous were represented by the cavernous hemangioma and by the lachrymal apparatus tumours.

- Cavernous hemangioma, 6 cases (11,32%)
- Capillary hemangioma, 2 cases (3,77%)
- Lymphoma, 2 cases (3,77%)
- Optic nerve glicoma, 3 cases (5,66%)
- Optic nerve sheath meningioma 1 case (1,88%)
- Epidermoid tumour, 2 cases (3,77%)
- Adenoid cystic carcionoma of the lachrymal gland, 2 cases(7,54%)
- Lymphangioma, 2 cases(7,54%)
- Lachrymal sac carcinoma, 1 case (1,88%)

Cavernous hemangioma was seen in 7 cases, accounting for 13.20% of all cases under study. (Figure 10-13)

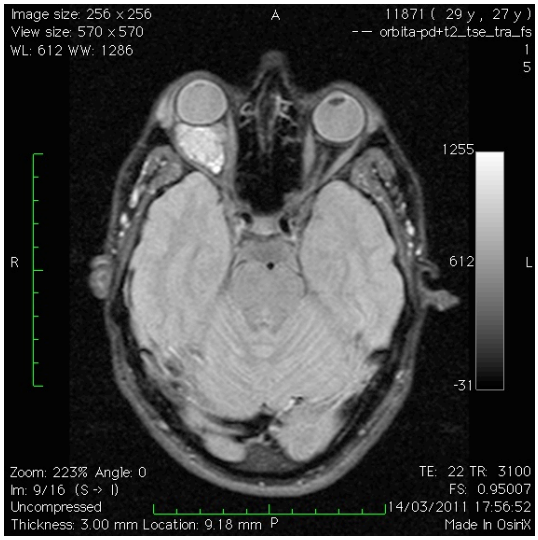


Figure 10-13. MR examination of a 26-year-old patient, with cavernous hemangioma,, whom I have operated in a mixed team with the ophthalmologists of the Neurosurgery Clinic of Sibiu; MR axial section highlighting an expansive retrobulbal, intraconal, supra- and suboptical process at the level of the right orbit.

Capillary hemangioma is the most common vascular tumour in children, affecting 83% of cases the anterior orbit and the eyelids. Myopia and astigmatism are associated. In 70% of cases, it regresses at the age of 7.[96,97] Visceral hemangiomas are also associated or those located in the skin or in the subcutaneous tissue. It may regress spontaneously.

Optic nerve glioma occurs frequently in neurofibromatosis of type I, being one of the diagnostic criteria for this disease. In the current study, none of the three patients had suffered from neurofibromatosis. Optic nerve glioma cases under study were operated because of the worse clinical status of the patients.

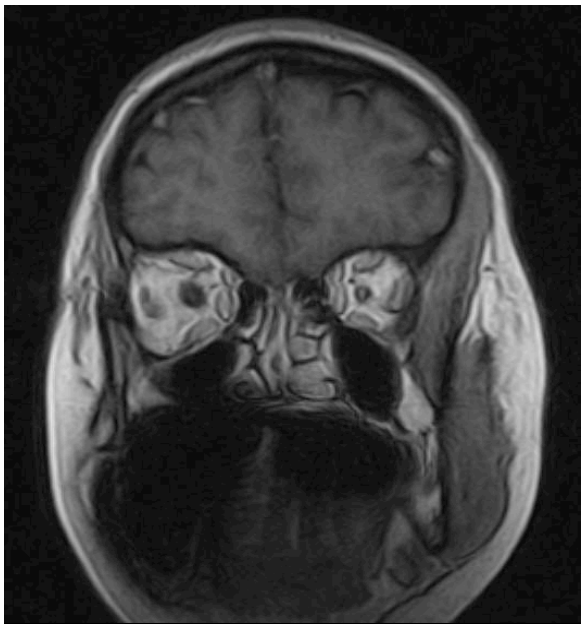


Figure 10-14. MR, coronal section, T1 postcontrast. The image reveals the thickening of the optic nerve with optic nerve isointensly thickened by the brain. It is the case of a female patient, aged 26, who after five years of clinical and imaging follow- within the Ophthalmology Clinic of Sibiu, has registered a clinical worsening of the visual disorders up to blindness, which required surgery.

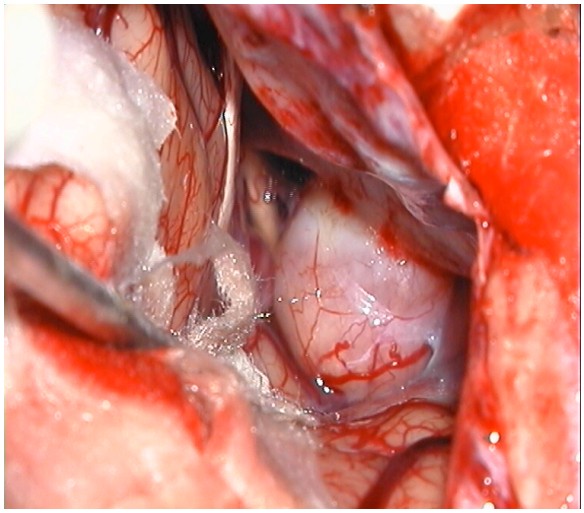


Figure 10-16. Optic chiasm glioma. A, Intraoperative aspect. Patient operated in the Neurosurgery Clinic of Cluj-Napoca. The much dilated optic nerve tumour can be seen after the frontal lobe retraction and the partial dissection of the Sylvian valley. We proceeded to the optic nerve tumour ablation with the resection of the optic nerve, which prevents the tumour process to extend controlateraly.

It remains a pathology with a management based on the clinical and imaging follow-up, the surgical indication being reserved in the cases with unilateral blindness, endocrine disorders through the invasion of the hypothalamus, hydrocephaly or with marked progression of lesions upon the neuroimaging examinations. [105]

Orbital lymphoma is the most common orbital tumours in adults, representing 2% of all lymphomas and 10% of all orbital tumours.

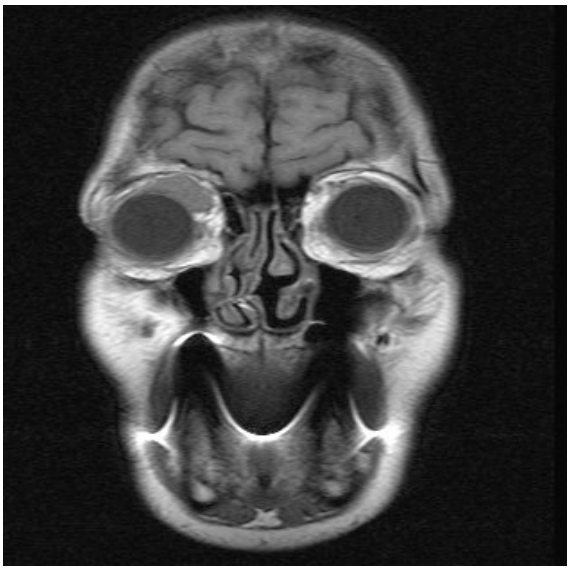


Figure 10-17. MR examination of a 53-year old patient, hospitalized and treated within the Clinical County Emergency Hospital of Sibiu for orbital lymphoma. The image is a coronal section, T1 sequence and reveals an extraconal tumour, which surrounds the eyeball, being located supraoptically. A subtotal ablation has been practiced, followed by chemoradiotherapy.

In the present study, 2 cases of orbital lymphoma, representing 3.77% of cases can be noticed.

The distinction between the primary and the secondary lymphoma is somewhat arbitrary and it is difficult to make, requiring additional examinations, as part of a comprehensive oncology review. [2,40,57]

Optic nerve sheath meningioma was present in one case only, representing 1.88% of all cases. Optic nerve sheath meningiomas are benign tumours usually present in adults, and evolving gradually with the decrease of vision.[6,106,107] Optic nerve meningioma can be primary or secondary. Surgical resection may be associated with high morbidity, reason for which the treatment usually consists of radiotherapy.[108,109] The treatment of choice is the stereotactic radiotherapy.[110, 111] In the recent years, remarkable progress has been made in the field of stereotactic radiosurgery using the GammaKnife or lately, the CiberKnife. [112,113]

Lymphangioma was present in two cases, representing 3.77% of cases. This is the most common orbital tumour in children, comprising, according to certain studies, 0.3 to 1.5% of all orbital tumours.[114,115] In our study, there were two cases, a patient aged 12 years old and the other aged 28 years old.

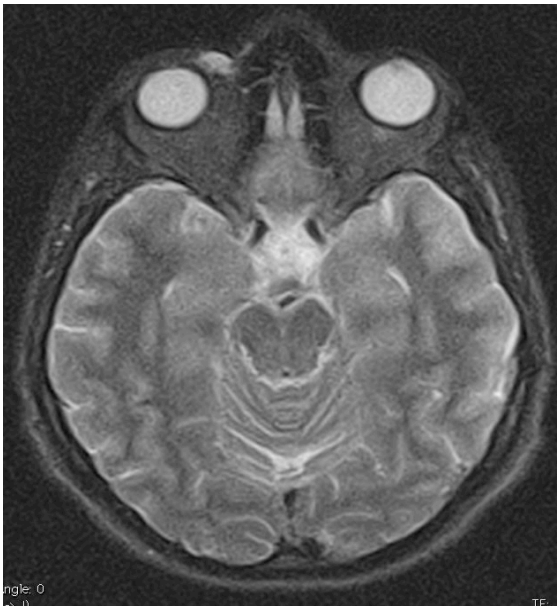


Figure 10-18. MR examination of a 28-year old female patient with lymphangioma at the level of the right orbit, the supero-internal angle, hospitalized and operated in the Ophthalmology Clinic of Sibiu; axial section, T2 sequence.

Regarding the lachrymal gland adenoid cystic carcinoma, we had 2 cases, meaning 3.77% of all cases under study. This is the most common malignant tumour of the lachrymal gland. It affects both genders equally and has a peak incidence at the age of 40, with patients aged between 6 years old and 79 years old. In the present study, the patients with such tumours were 28 years old and 43 years old. (Figure 10-19)

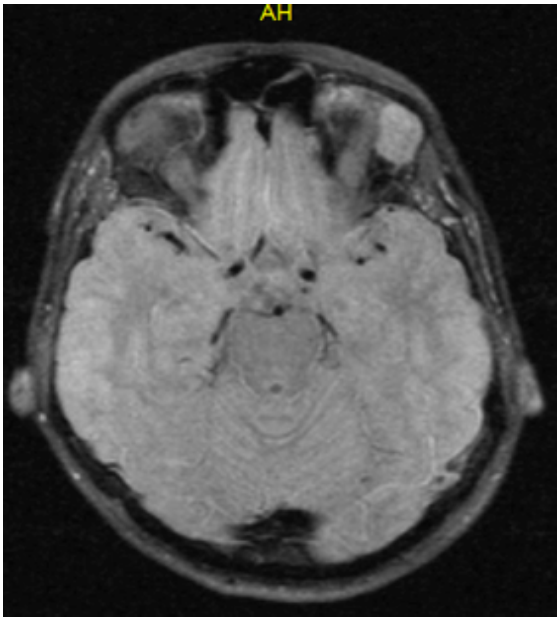


Figure 10-19. MR examination of a patient, aged 28 years old, whom I have operated in the Neurosurgery Clinic of Sibiu, for lachrymal gland tumor, the histopathological examination revealing an adenoid cystic carcinoma of the lachrymal gland.

In personal experience, both patients with adenoid cystic carcinoma refused the radical orbitectomy and therefore, we proceeded to lateral orbitotomy with tumor resection and postoperative radiotherapy of 50-60 Gy. One of them had relapsed 1 year later, with bone invasion and after a thorough discussion with the patient regarding the treatment alternatives, we performed the resection of the tumour recurrence with the ablation of the tumor infiltrated bone (histopathology confirmed free margins of resection) with the lateral wall reconstruction of the orbit with titanium dynamic mesch.

10.4 Discussions about the surgical treatment

10.4.1 Preoperative assessment

The preoperative assessment should begin with the medical history of the disease and with the physical examination of the patient, no matter how obvious the diagnosis is. The clinical examinations, both systematically and clinically, as well as the local examination provide important details, are representing the key to the proper treatment. It is important that the patient and his family agree on surgery. There are surgeons who prefer the audio or video recording of the preoperative discussion and the patient's consent. In the uncertain situations, when the accomplishment of a biopsy is foreseen, the patient is clearly explained its necessity.

The simple therapeutic procedures should usually be made before the complex ones.[2] For example, in case of an apical tumour, the biopsy ("fine needle aspiration") may precede the transcranial orbital approach.

10.4.2. Preoperative preparation

Imaging examinations have become essential, both in diagnosis and in the management of the orbital lesions. Imaging evaluation includes ultrasonography, computed tomography and magnetic resonance (MR).

Recent advances in radiology, such as Doppler ultrasound, MR diffusion (diffusion-weighted MR), cine MRI, MR spectroscopy and positron emission tomography (PET) can provide data on the nature of the orbital lesion.[47,54] Most surgery interventions in adults and all interventions in pediatric age patients are performed under general anesthesia. Occasionally, surgical interventions through anterior orbital approach and biopsies in adults can be performed under local anesthesia.

10.4.3 Surgical general principles

Patient's position

The optimal position in orbit surgery is "reverse Trendelemburg", which reduces blood flow and venous stasis.[2,40] The head is positioned according to the type of orbitotomy. Surgical field preparation is done with Betadine and it generally involves the concerned orbital region.

Skin incision at the level of eyelids and periorbital area should follow the folds. For the eyebrow region, in eyebrows, the incision is made at an angle of 45 degrees,

following the hair follicles. In orbit surgery, osteotomy is most commonly performed to facilitate the access to the orbital tumour lesions, but it can also be performed for the local control of some cancers (when the bone is removed).

The orbit is a cavity difficult to approach and explore, traversed by vascular-nervous-vascular structures, in a mass of adipose tissue separated by fibrous septa. In the previous surgical approaches, orbit exploration starts anteriorly, requiring on dissection progression, three-dimensional good view, anatomical knowledge and a great skill of the surgeon.[40,115] Moreover, the presence of the tumoral process changes a lot the regional anatomy, making the orbital cavity exploration more difficult. For these reasons, the exposure through an appropriate approach is of paramount importance. Orbital fat may be tractioned with sutures, can be elongated with a spatula, preferring to use the blunt dissection techniques. Regarding the elongation methods, used in orbital surgery, the following are cited: Desmarres manual retractors, Semmit and Ragnell, Graff and Jameson muscle hooks, Freer or Josph skin hooks, sutures 4-0 or 5-0, silk or Vicryl applied to distance the eyelids or other tissues, Brown-Adson forceps.

It is very important to preserve a clean operator field, avoiding the stagnation of blood in the field, but also the damage and the coagulation of the important blood vessels. Hemostasis can be achieved by bipolar or unipolar coagulation with fine needle of Colorado type. In bone, hemostasis is achieved by wax.

Regarding the reconstruction of the orbital walls, there has been used titanium dynamic mesch fixed with titanium screwed.

Figure 10-20. Titanium screws that I used in orbit reconstruction and of the skull base, anterior floor.

For the subcutaneous tissue and skin, silk, nylon or rapidly absorbable suture can be used.

10.4.4 Discussions about choosing the approach

All those 53 patients received a surgical procedure. Regarding the surgical treatment in the study patients, five biopsies were performed (9.43% cases) in the patients with: 1 case of pulmonary adenocarcinoma metastasis, metastatic breast cancer 2 cases, 2 cases of lymphoma.

Indication for biopsy was determined according to: the age of the patient, the patient's associated diseases, imaging features, suggestive for lymphoma or pseudotumour.[56]

In 36 cases (67.92% of cases), tumour location imposed choosing a transcranial approach, in 16 cases, meaning 30.18% of cases orbital tumours were approached trans-orbitally. As I previously mentioned in one of the cases, it was about a patient with skull base tumour, anterior floor, with ethmoid and maxillary sinus invasion and orbit secondary invasion. In this case, we proceeded to a mixed approach, trans-sinusal and transcranial, so that after tumour resection from the maxillary sinus, the trans-sinusal ablation of the infraoptic intraconal orbit tumour has been succeeded and later on, by transcranial approach, the part of the medial, intraconal and supraoptic tumour has been resected.

Among the 36 cases which received a transcranial approach, this one was represented by a fronto-temporal classic approach in 26 cases. In the remaining 10 cases, fronto-temporal craniotomy was practiced associated with higher orbitotomy. This orbitotomy was always performed leaving in place the supraorbital arch.

In choosing the surgical approach, a decisive role is played by the material equipment. For example, within lateral orbitotomy, when receiving Neuronavigation technology or the intraoperative ultrasound, one may proceed to a minimal approach, of the "Key-Hole" type, with the performance of orbitotomy, lesion-centred and strictly delimited.

I have seen such therapeutic attitude in Germany, within the internship made at Zentralklinik Bad Berka, where the use of Neuronavigation allowed the use of minimal orbitotomies with higher cosmetic effects.

I personal think that the supra-eyebrow incision with posterior-lateral extension in "S italic" is ideal for this approach, without the need for incision and temporal muscle retraction, as it is practiced for the fronto-temporal incision, when the temporal muscle manipulation leads to postoperative discomfort but also to a possible transient paresis of the frontal ram of the fascial.

The surgical treatment addressing orbital tumours include many surgical approaches, chosen depending on the location and extent of the tumour and on the overall clinical status of the patient.

Generally, the previous injuries are treated by transorbital approaches, while the orbit lesions one third posteriorly undergo extraorbital approaches. In addition to the tumour localization process, there are a number of factors to be taken into account in choosing the surgical approach: the size of the lesion, the aim of the surgery (biopsy, decompression or tumour total ablation), as well as the tumour imaging characteristics (degree of infiltration of the adjacent tissue, vascularity, multilocularity)[3,40,44,45]

The tumours placed anteriorly are surgically treated by anterior superior of inferior orbitotomy. For the giant lesions, located antero-superiorly, additional osteotomy can be practiced. Laterally located tumours are approached through lateral approach, which may sometimes be extended back to the sphenoid wing, thus allowing a better visualization of the posterior, lateral tumours.[3,40]

Postero-inferior lesions located between the optic nerve and the right inferior muscle are excised by inferior orbitotomy, sometimes involving an ENT surgeon, his participation being also needed in the surgical approaches of the tumours invading the ethmoid cells or the paranasal sinuses. The endoscopic techniques can make a significant contribution in case of a complete excision, in the minimally invasive procedures.[3,32,40,43]

The lesions with intracranial extension are best approached through an extraorbital fronto-temporal approach. This approach is also used in cases of tumours located in the apex of the orbit or at the level of the optic nerve canal. The tumours located postero-laterally, at the level of the superior orbital fissure can be excised through a pterional approach.

10.5 Discussions about complications

The most serious complication and also the rarest, is the damage to important structures such as nerves, vessels, muscles and the eyeball. Once such a lesion is found during surgery, first it is repaired and only subsequently, the intervention is continued. CSF fistula recognized intraoperatively, regardless of location or type of approach, is preferable to be immediately resolved by direct suture and possibly by FibrinGlue application.[117,118,119]

For larger defects, plasty with temporal fascia can be practised, or with fascia lata or other substitutes. For fistulae difficult to highlighted, muscle or fat tissue can be used for filling, over which FibinGlue can be applied. Postoperatively detected CSF fistulas are drug treated (antisecretory, depletion therapy) and repeated lumbar punctures or continuous lumbar drainage. In this study, when practicing the fronto-temporal craniotomy, in 4 cases frontal sinus opening occurred, which was recognized intraoperatively; this was not considered an incident, but rather a surgical time, especially in cases when the tumour invades the frontal sinus or when the most efficient exposure of the skull base is wished for.[120,121] Also, this happens routinely in the fronto-orbito-zygomatic craniotomy, and I am not very found to it, just for this reason.

Vascular lesions and diffuse bleeding represent complications requiring the discontinuation of the intervention and addressing the cause of bleeding. Haemostasis is done methodically, patiently, with source identification, cauterization and vascular ligation. Diffuse bleeding is controlled with Gelgfoam, Surgicel dressing.[122] Excessive application of wax to the bone should be avoided due to the foreign body reaction that can occur and due to the bone healing delay.

Postoperative complications

Postoperatively, I encountered the following complications:

- CSF fistula in two cases and in one of them, the surgical reintervention was required for closing the fistulous orifice;
- Postoperative bleeding with postoperative hematoma in 2 cases, a patient with a tumour of the lachrymal gland and a patient with meningioma of the sphenoid wing; in both cases, emergency reintervention was required with the postoperative hematoma evacuation with subsequent favourable evolution;
- A case of infection, one week postoperatively in a patient with adenocarcinoma of the paranasal sinuses, in whom reintervention was made in order to cure the infectious outbreak, 48-hour drainage-lavage and antibiotic treatment, with subsequent favourable evolution;
- A case of keloid scar after an anterior approach for lymphangioma, which was surgically treated in the Plastic Surgery Clinic;

- 2 cases with postoperative superficial wound infection, in whom wound suture per-secundam was performed, after the antibiotic therapy adapted to the antibiogram.

Because of the small size of the orbit, any dimension of a postoperative hematoma can raise problems. To prevent this, ice application can be used and the lifting of the cephalic extremities in the first 24-48 hours.[115,123,124] Staff training is required to observe and report immediately the sudden occurrence of an exophtalmia, loss or decreased vision, pain.

The acute increase of the intraorbital pressure can cause compressive optic neuropathy and hypoperfusion of the optic nerve and retina. In case of a painful exophtalmia and a postoperative hematoma is suspected and the patient still has drainage, drainage manipulation can be firstly tried, with slight movements or its desobstruction. But this gesture is often inefficient because of the presence of septa partitioning the orbital cavity. In terms of medication, acetazolamide and mannitol can be associated.

The imaging investigations can reveal the exactly hematic collection and depending on age, its extraction can be tried with a puncture-aspiration with a needle of 20 Gauge.[2] This manoeuvre can be guided by ultrasound or CT.

If all the above-mentioned methods fail to control the intraorbital pressure, reopening is practiced with the performance of the hemostasis and placement of a new drainage.

Preventing the increase of the intraorbital pressure due to bleeding is achieved through: exploration of the orbit, careful hemostasis, placing a slightly closed suction drainage, careful extubation of the patient, ice application immediately after the surgery, avoiding any intense compressive dressing.

However, the presence of postoperative bleeding chemosis cannot be avoided; it is easily treated with eye ointment and eye washes. Sometimes, a semisolid chemosis can be seen at the inferior fornix level, which is bandaged with ointment and a compression bandaging can be applied for 24 hours.

Excessive intraoperative traction and blunt dissection techniques can cause motor or sensory deficits. Most of these complications occur after lateral orbitotomy.[124,125] The complications of the lateral orbitotomy include extraocular motility disorders (particularly abduction deficit) and loss of pupillary reflexes.

Chapter XI
CONCLUSIONS

- Orbit tumours are a rare pathology in the medical practice, so that their diagnosis and treatment is a challenge for the clinician and requires deep anatomical and clinico-imaging knowledge. Within the doctoral study, I resorted to anatomy studies through cadaver dissection of the cranio-orbital junction, highlighting the vascular-nervous structures crossing this passage.
- Among the symptoms of the orbital tumours onset, the most common is exophtalmia; in our study, it was present in 31 cases, accounting for 58.49%.
- The final diagnosis of any neoformation process is based on tissue examination, exam that represents the final and essential element for diagnosis, staging and treatment. Tumour diagnosis revealed a large heterogeneity of the study group, being well known the fact that due to the wide variety of tissues that are at orbit level, a large variety of tumour types can arise. Thus, in the study group, one can see that in 32 cases (60.37% of cases), we had secondary tumours of the orbit, and the remaining 21 cases (39.62%) were diagnosed as primary tumours.
- The total resection of the tumour was the main objective in all cases of our study, and it succeeded in most cases. In the study group, 40 patients received a total tumour resection (75.47% of patients), 8 patients (15.09% of patients) a subtotal resection, and 5 patients (9.43% of patients) received puncture biopsy.
- The extemporaneous examination is an important adjuvant to obtain higher surgical outcomes; it has been used in 5 cases (lachrymal gland tumour 2 cases tumour of the paranasal sinus 2 cases, metastasis, 1 case) to verify tumour resection rate by tumour excision margins research.
- We aimed at bringing into actuality a term used since 1975, the term of cranio-orbital junction, the region that includes the orbital apex with optic foramen and superior orbital fissure, being affected in many tumour, traumatic, infectious, vascular, endocranial or orbital pathological processes. In this study, there were 25 patients (47.16%) with meningioma of the inner third sphenoid wing and tuberculum selae.
- In 36 cases (67.92% of cases), tumour location imposed choosing a transcranial approach, in 16 cases, meaning 30.18% of cases the orbital tumours were transorbitally approached and in one case, we used a transcranial approach

combined with a para-latero-nasal approach with nasal translocation. For the transcranial orbital approach, we preferred leaving in place the upper and lateral orbital arch, this having the advantage not only of achieving higher cosmetic results but also of significantly shortening the surgical time.

- The lateral approach of the orbital cavity is an elective option for the tumours located in the supero-external angle of the orbit, and for the tumours located in the lateral or infero-lateral part of the orbit. The technical possibilities are numerous, but the incision in S italic, the orbitotomy centred on the lesion and adapted to the tumour size, complete tumour ablation with oncological safety limits, followed by the bone restoration and anatomical closure are essential surgical times to obtain good oncological and aesthetic outcomes. Thus, within the lateral approach, orbitotomy size can be adapted according to the location of the tumour process. Neuronavigation and intraoperative ultrasound also contribute to achieving superior results.
- Reconstruction of the skull base, at the level of the anterior floor and of the orbit walls was performed with titanium dynamic mesch, which contributed to good functional and cosmetic results, with the prevention of the postoperative enophtalmia and last but not least, positively influencing the patients' quality of life.
- Orbital tumours treatment is multimodal and multidisciplinary, involving the individualized therapeutic decision for each case, the presence of ophthalmologist, neurosurgeon, ENT or BMF surgeon, radiotherapist, oncologist, in which surgical resection plays the major part.
- Achieving higher rates of survival and a better quality of life in the patients with orbital tumours is based on a postoperative sustained clinical and imaging follow-up. We elaborated a score to follow up the patients with orbital tumours postoperatively, based on the degree of tumour resection, tumour type (malignant or benign) and the clinical condition of the patient at discharge, assessed by the Karnofsky score.

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